A study on possible gamma ray interferences from 60mCo, 139Ba and 56Mn formed in the direct thermal neutron irradiation of LaBaCo2O6 e LaBaMn2O6 perovskites to produce 140La(140Ce) probe nuclei for PAC spectroscopy

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In this work, a method to introduce radioactive 140La nuclei with a half-life (t1/2) of 40.8 h, into samples of LaBaTM2O6 (TM = Mn, Co) double perovskites is described to carry out perturbed gamma-gamma angular correlation (PAC) spectroscopy measurements using 140La(140Ce) as probe nuclei. There are several methods to insert this probe nucleus in the samples and the present paper presents a new methodology to obtain the 140La(140Ce) in the compounds. These compounds were submitted to short irradiations with thermal neutrons in the rabbit station of IEA-R1 nuclear reactor of the IPEN/CNEN-SP. This method could be used because natural La is present in samples. Natural La contains the 139La isotope which, when irradiated with neutrons produces the 140La radioisotope, the parent radioisotope of 140Ce used for PAC measurements. However, other elements present in the compounds are also activated, in particular the isotopes 56Mn, 139Ba and 60mCo. In order to verify if these radioisotopes are presents in the PAC measurements, the gamma ray spectra of these irradiated samples can be measured at different decays times using a high resolution HPGe spectrometer. Samples were irradiated with thermal neutrons for 3 minutes. After short irradiation, the gamma ray spectra were acquired, one hour, 18 h, 24 h and 48 h after irradiation. The gamma ray energies of 328.8 keV and 487.0 keV of 140La (measured in the PAC spectroscopy) can be identified. Besides this, gamma-rays peaks of 56Mn (Eγ of 847.3 and 1812.9 keV and t1/2 of 2.57 h), 139Ba (Eγ of 166.04 keV and t1/2 of 84.63 min) and 60mCo (Eγ of 58.75 and 1333.30 keV and t1/2 of 10.47 min) are identified too. The results indicate that PAC measurements can be started after at least 48 h of decay time when there is in interference of other radioisotopes.

Determination of gadolinium and erbium in Gd2O3 and Er2O3 nanoparticle samples by neutron activation analysis

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Along these years the applications of nanoparticles (NPs) in medicine as radiosensitizers have been widely studied, so several methods for its syntheses are presented. One of the best synthesis methods for this application is by thermal decomposition, which produces small NPs size (3-5 nm) with a narrow size distribution. On the other hand NPs synthetized by this method are covered by an organic material, hence making their mass measurement impossible by conventional means. In this study neutron activation analysis (NAA) was applied to determine Gd and Er concentrations in their NP oxides. The analysis of NPs composition is not commonly carried out. However these determinations are of great importance when the NPs are used in radiosensitization tests and magnetization measurements. NPs were synthetized by the method of thermal decomposition, which consisted in adding and mixing Gd and Er acetate in an organic solution by stirring and heating at high temperature (about 573 K) for about six hours. After cooling at room temperature the solution was centrifuged to obtain the NPs that were separated from the liquid. For NAA about 5 mg of post-synthesis and 873 K annealed samples of Gd2O3-NP and Er2O3-NP were irradiated together with their respective element standard. One-minute irradiations were carried out at the IEA-R1 research nuclear reactor. Element concentrations were determined by measuring 159Gd and 171Er gamma ray activities (energy of 363.56 keV and 308.3 keV respectively). Concentration of (19.88 ± 0.43) % of Gd and (23.53 ± 0.82) % of Er were obtained in the Gd2O3-NP and Er2O3-NP samples, respectively. These results are useful and have been used to establish experimental conditions for NPs magnetization and irradiation in radiotherapy beams for dose enhancement factor determination.

Inverse Analysis of Irradiated Nuclear Material Gamma Spectra via Nonlinear Optimization

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This work applies nonlinear optimization to the inverse analysis of gamma spectra measured from pulse irradiated nuclear materials. The algorithm described is used to estimate the fluence, cooling time, and sample composition to help in determining the